SUMMARY OF FINDINGS
STRIVE Report No. 2008-FS-S-5-S5

The Application of Geophysics to a Number of Threats to Irish Soils

Author: Dr. Shane Donohue
Lead Organisation: University College Dublin

This research fellowship has applied a number of geophysical techniques in conjunction with conventional approaches, to a number of areas of concern in relation to threats to Irish Soils. Although some limitations were observed, the approaches applied successfully detected agriculturally compacted soil, significantly improved our understanding of wastewater plumes associated with failed residential treatment systems and assisted our understanding of failures occurring in raised bogs.

Key Words: Soil, Thematic Strategy for Soil Protection, Proposed Soil Framework Directive, Geophysics, Compaction, Wastewater Contamination, Water Framework Directive, Peat

Background

In its 2002 Communication "Towards a Thematic Strategy on Soil Protection" (COM 2002, 179), the Commission identified the main threats to which soils in the EU are confronted. More recently, the EU published a Thematic Strategy for Soil Protection (COM 2006, 231) as well as a proposal for a Soil Framework Directive (COM 2006, 232). The proposed directive, if implemented, will require states to identify a number of specific soil degradation processes that have occurred or are likely to occur in the near future. This project applies a number of recent geophysical developments, in addition to a range of traditional approaches, to a number of areas of Irish concern to Thematic Strategy for Soil Protection and the proposed Soil Framework Directive.

Key points

The areas that were investigated as part of this project were of particular concern in relation to:

- **Agricultural Compaction:** Exploring the possibility of using geophysical measurements as alternatives to conventional methods for detecting agricultural compaction. The use of high speed alternative geophysical measurements, were also trialled.
- **Wastewater Contamination:** Establishing the effectiveness of a number of geophysical techniques for characterising the 3D extent of contaminant plumes generated by wastewater treatment system effluent discharging to glacial-till subsoils. This project was performed in collaboration with Dundalk Institute of Technology (DKIT) and Queen's University Belfast (QUB).
- **Landslides in Raised Bogs:** Investigating the causes of Irish raised bog failures using a combination of field geophysical, geotechnical and laboratory geotechnical testing. The

information from these investigations was then used in slope stability and seepage analyses to further predict the causes of these failures.

Findings/Recommendations

Agricultural Compaction:

The geophysical methods trialled detected significant differences between compacted and uncompacted ground, and correlated well with conventional assessments. The geophysical methods tested have a number of advantages such as their non-intrusive nature and the ability to acquire a large amount of data, relatively quickly, particularly if portable systems are employed. Currently, no comprehensive data are available on the severity or extent of soil compaction in Ireland. This would be a valuable resource. Further assessment of the geophysical techniques used in this project for compaction assessments is recommended on a range of soils, other than those tested in this project.

Wastewater Contamination:

Geophysical data significantly improved our understanding of wastewater plumes associated with failed residential treatment systems and assisted in identifying potential effluent pathways. In addition, when combined with the findings of a recent DKIT/QUB study, this study further highlights the need for an appropriate inspection system that is capable of detecting pollution arising from malfunctioning systems to be put in place. Currently, there is a general lack of information regarding rates of failure of existing on-site wastewater treatment systems (OSWTS) and the degree of remediation work required. Geophysics has the potential to assist assessment of malfunctioning OSWTS in this regard.

Landslides in Raised Bogs:

An integrated geophysical and geotechnical investigation, when combined with slope stability and seepage analyses, have shown that seepage induced forces were the most likely cause of the raised bogs failures investigated. Due to the presence of drains at the edges of the failed areas, these forces will continue to exist. The existing cracks will continue to open and new cracks will develop causing further damage. It is recommended that, where infrastructural development is planned in close proximity to peatlands, a significant effort should be made to ensure than drainage of the peat does not occur.

For Further Information

This report (STRIVE Report N. 126) is published as part of the Science, Technology, Research and Innovation for the Environment (STRIVE) Programme 2007–2013. The full report is published by the EPA and is available from: http://www.epa.ie/pubs/reports/research/land/

Publications connected to this work

Donohue, S., Forristal, D. and Donohue, L.A. 2013. Detection of soil compaction using seismic surface waves. *Soil & Tillage Research* 128: 54-60.

Donohue, S., Flynn, R., McCarthy, V., Orr, A., Rafferty, P. and Galvin, K. 2010. Geophysical assessment of contamination from a wastewater treatment system in the Milltown lake catchment, Ireland. EAGE Near Surface 2010, 16th Annual Meeting of Environmental and Engineering Geophysics, Zurich, September.

Long, M. Trafford, A. and **Donohue, S.** (2014). Investigation of failures in Irish raised bogs. *Landslides,* DOI: 10.1007/s10346-013-0440-2